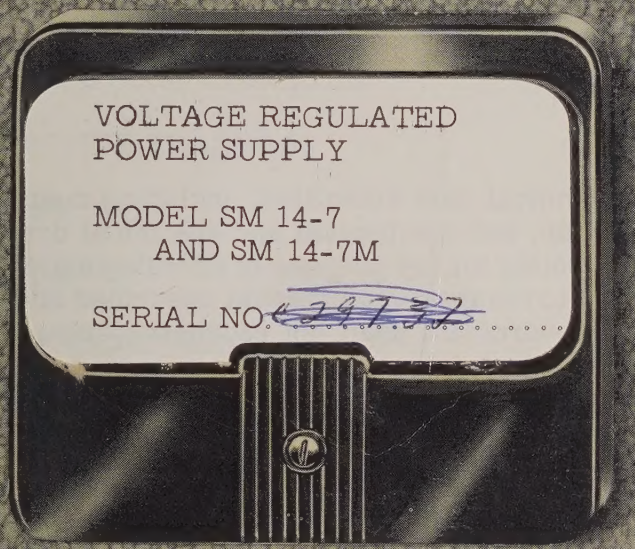
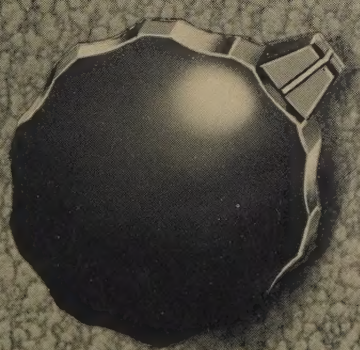
Kepco INSTRUCTION MANUAL



BOEING

✳ VOLTAGE REGULATED POWER SUPPLIES



Kepco Inc.

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SPECIFICATIONS AND CONTROLS FOR MODELS SM 14-7 AND SM 14-7M

I. ELECTRICAL AND PHYSICAL SPECIFICATIONS:

....DC OUTPUT VOLTAGE:
0-14 volts DC, continuously variable.

....DC OUTPUT CURRENT:
0-7 amperes, continuous duty.

....AC INPUT:
105-125 volts, 60 ± 1/2 cps, 3.07 amperes (max.)

....REGULATION:
Line: 0.1% for 105-125 v line change at any output voltage within specified range.
Load: 0.1% or 0.003 v, whichever is greater, for 0 to 7 amperes load change, at any output voltage within specified range.
REMOTE ERROR SENSING feature provides means of maintaining specified regulation directly at load. (see P. C-2).

....RIPPLE:
Less than 0.001 volts rms.

....STABILITY:
Output voltage variation is less than 0.1% over a period of 8 hours, after unit has reached equilibrium. Approximately 3/4 of an hour is required for this unit to reach equilibrium from a "cold start".

....OUTPUT IMPEDANCE:
Less than 0.002 ohm from DC to 1 KC.
Less than 0.02 ohm from 1 KC to 100 KC.

....RECOVERY TIME:
50 microseconds.
Recovery time is defined as the time required for the output voltage to return to within 0.1 volts of the output voltage setting.

....TEMPERATURE COEFFICIENT:
Output voltage changes less than 0.05% per unit C.

....AMBIENT OPERATING TEMPERATURE:
-20 C to +50 C maximum. Protective circuit turns off unit whenever over-temperature condition occurs in pass elements. Interrupting input power resets unit.

....STORAGE TEMPERATURE:
-40 C to +85 C.

.... DIMENSIONS:
3-1/2" high x 19" wide x 13-7/8" deep (behind panel).

.... COLOR:
Kepco Standard Gray Hammertone.

.... METERS: (APPLIES ONLY TO MODEL SM 14-7M)
Voltmeter: 0-15 volts, 2-1/2".
Ammeter: 0-8 amps, 2-1/2".

II. TERMINALS AND CONTROLS:

.... (On front panel):
.... DC OUTPUT AND GROUND binding posts, clearly marked. Output terminals isolated from chassis; either positive or negative terminal may be grounded.
.... VOLTAGE CONTROL, continuously variable, for setting output voltage.
.... POWER ON-OFF SWITCH, energizes power and auxiliary transformers.

.... (At rear of unit):
.... DC OUTPUT AND GROUND binding posts, clearly marked; either positive or negative terminal may be grounded.
.... REMOTE ERROR SENSING binding posts provide means of maintaining specified regulation directly at load. (Diagram and Procedure on P. C-2).

III. PROTECTIVE FEATURES:

.... FUSE PROTECTION:
.... POWER input fuse (ac) on front panel.
.... DC output fuse (ac) on front panel.
.... REFERENCE fuse (ac) protects internal circuitry.

.... OVERLOAD PROTECTION:
Provided by inherent current limiting action of Kepco "FLUX-O-TRAN" transformer. Output may be shorted momentarily without damage to unit. Continuous overload or short will blow DC FUSE.

.... OVER- TEMPERATURE PROTECTION:
Thermostat relay control turns unit off if temperature of pass elements exceeds safe limit. Relay is reset by interrupting input power with ON-OFF switch on front panel, or by disconnecting line cord from power source.

SECTION B

BRIEF THEORY:

Two circuit schematic drawings titled 'POWER UNIT' and 'CONTROL UNIT" are included in the Reference Index of this instruction manual. These drawings contain designations corresponding to the capitalized terms in the following discussion.

Some basic functional relationships in this power supply are illustrated in block Diagram B-1 (Page B-2A).

The POWER UNIT includes:

DC SOURCES:

....MAIN SUPPLY - (consisting of a Kepco 'Flux-O-Tran' transformer, full wave bridge rectifier, and capacitive filter) provides line regulated DC power for the output, via the PASS CIRCUITRY.

....AUXILIARY SUPPLIES: COLLECTOR SUPPLY (negative full wave rectified) for PASS CIRCUITRY driver stages not connected to MAIN SUPPLY; I_{CO} SUPPLY (full wave rectified) compensates for spurious biasing effects of collector leakage current; RETURN SUPPLY (full wave rectified) acts as leakage current path for series pass transistors and as bleed path to provide minimum operating current for pass transistors; CONTROL UNIT SUPPLY (full wave rectified).

PASS CIRCUITRY:

The power transistors which function as pass elements (i.e. are in series with the load) may be regarded effectively as variable resistors (or conductors) controlled by a CONTROL SIGNAL. The current "passed" by these elements is a function of the emitter-base bias. The CONTROL SIGNAL is applied to the base terminal; hence a negative CONTROL SIGNAL will aid the forward conduction of a PNP transistor while a positive CONTROL SIGNAL will reduce the forward conduction. In response to the CONTROL SIGNAL the pass elements effect a current and voltage distribution in the main DC loop which holds the output voltage constant.

The CONTROL UNIT includes:

REFERENCE CIRCUITRY:

The function of the REFERENCE CIRCUITRY is to maintain a precise, stable, voltage standard for the COMPARISON AMPLIFIER.

COMPARISON AMPLIFIER:

The COMPARISON AMPLIFIER is essentially a series of cascaded transistor amplifiers which boost the differential error signal produced in the COMPARISON BRIDGE to a level sufficient to drive the PASS CIRCUITRY. The COMPARISON AMPLIFIER is connected across the COMPARISON BRIDGE from the junction of the VOLTAGE CONTROL and the REFERENCE RESISTANCE to the junction of the REFERENCE DIODE and the negative output terminal (See Diagram on Page B-2A). This arrangement is similar to that of a null galvanometer across a Wheatstone bridge. Unbalance in the COMPARISON BRIDGE is amplified to produce a CONTROL SIGNAL of suitable magnitude and phase to effect corrective action by the PASS CIRCUITRY.

COMPARISON BRIDGE: (See Diagram B-2, Page B-2A).

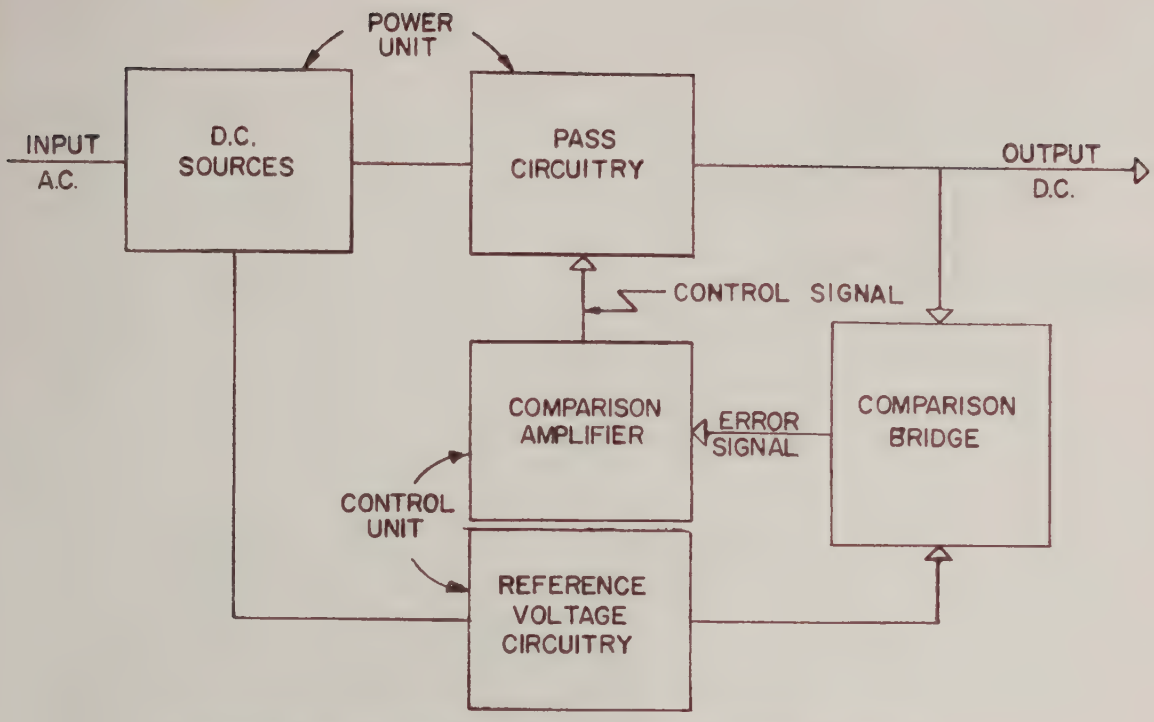
This bridge circuit implements the comparison between the OUTPUT VOLTAGE and the REFERENCE VOLTAGE. The signal produced by the comparison drives the COMPARISON AMPLIFIER.

Balance occurs in the Comparison Bridge when the following ratios are equal:

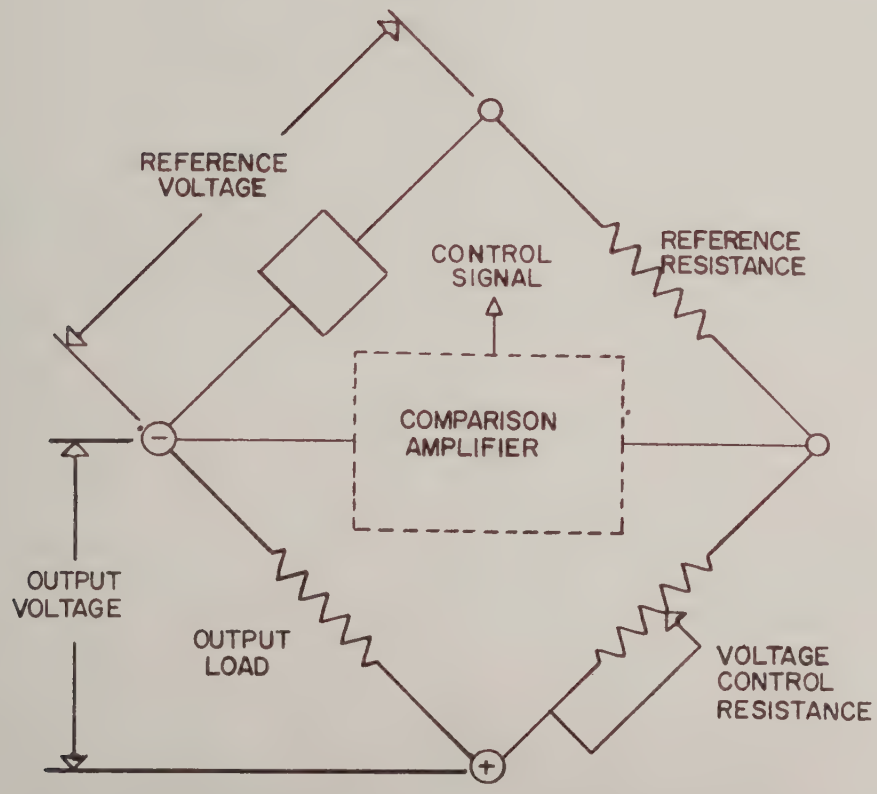
$$\frac{\text{Output Voltage}}{\text{Voltage Control Resistance}} = \frac{\text{Reference Voltage}}{\text{Reference Resistance}}$$

When, for example, the Comparison Bridge is unbalance by a decreasing output voltage drop across the load, it gives rise to a negative signal at the base of the COMPARISON FOLLOWER in the COMPARISON AMPLIFIER circuit. This signal is amplified in cascade and communicated to the pass elements as a negative base input aiding their forward conduction and consequently increasing the output voltage.

A bridge unbalance caused by an increasing output voltage produces, of course, a chain of oppositely biased circuit responses which reduce the voltage across the load.



(DIAGRAM B-1) *VOLTAGE REGULATED POWER SUPPLY*



(DIAGRAM B-2) *COMPARISON BRIDGE*

This power supply is shipped without any internal packing material; and may be put into operation immediately. It is designed for rack and for bench use. Carrying handles are provided on front panel.

....INTIAL "TURN - ON" PROCEDURE:

1. Adjust VOLTAGE CONTROL to approximate mid-range position.
2. With POWER ON-OFF switch set in "OFF" position, connect line cord to 115 v ac, 60 cps input power. If outlet is not polarized use 3 to 2 - prong adapter supplied with unit.
3. Set POWER ON-OFF switch to "ON" position.
4. Adjust VOLTAGE CONTROL to obtain desired output voltage.

....GENERAL OPERATION:

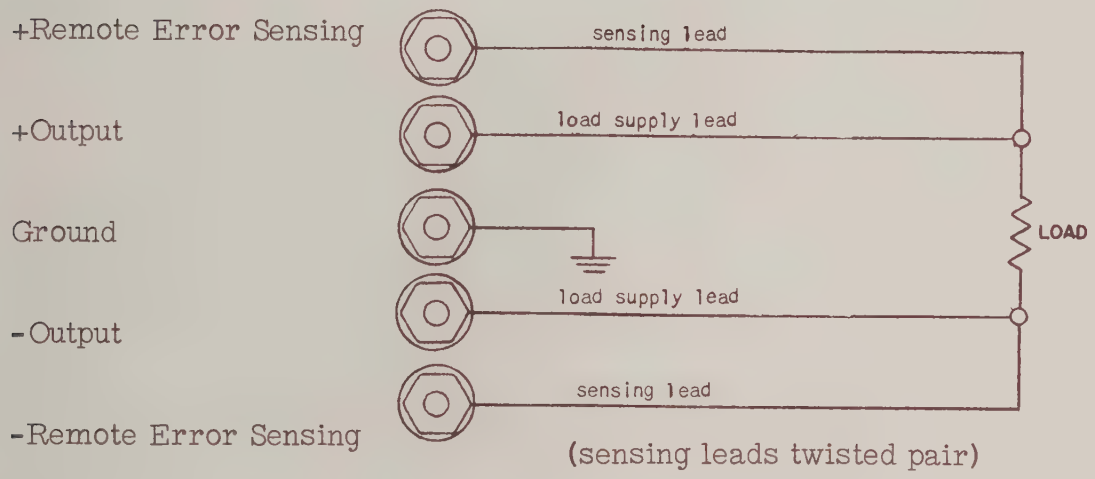
1. Once it has been determined that the unit is functioning satisfactorily, it is subsequently unnecessary to follow the INITIAL TURN-ON PROCEDURE.
2. The VOLTAGE CONTROL may be left fixed at any setting and the power turned "ON" and "OFF" without any harmful effects.

....MAINTENANCE AND REPAIR:

1. Under normal operating conditions, no mechanical maintenance of any kind should be required. Conservatively rated electrical components assure long trouble-free operating life.
2. Exceptional component accessibility, provided by resistor board construction and plug-in sub-assemblies, facilitates servicing, should it be required. It is emphatically recommended that trouble-shooting be handled by personnel highly familiar with transistor circuitry, - preferably with experience in closed-loop designs.
3. This unit should not be returned to the manufacturer without proper authorization and shipping instructions. In any correspondence with the factory regarding repair, the model, serial number, and symptoms of malfunction must be included.

REMOTE ERROR SENSING OPERATION

(Terminal Connections)



(sensing leads twisted pair)

(Procedure)

1. With AC input power disconnected, remove jumpers between plus and minus Output terminals and Remote Error Sensing terminals on the rear of the unit.

2. Using twisted pair wire, connect sensing leads from positive and negative Remote Error Sensing terminals to the load (observing polarities).

3. Using twisted pair wire, connect load supply leads from positive and negative Output terminals.

IMPORTANT NOTE: This unit should not be operated with Remote Error Sensing if the voltage drop across the load supply leads exceeds 0.5 volt (maximum) per lead at maximum rated output current.

Schematic Part No.	Kepco Part No.	Description	Specifications	Mfr.	Mfr's. No.
B201	148-0006	Motor		Barber Colman	KYAF764-1
		Capacitors:			
C101	117-0207	Mylar	1 µf 200 v 10%	Hopkins Eng.	1P2MK
C201	117-0288	Electrolytic, Can Type	11.4 K µf 30 v +150, -10%	Sangamo	DCM
C202	117-0287	Electrolytic, Can Type	19 K µf 30 v +150, -10%	Sangamo	DCM
C203	117-0169	Paper, Can Type	2 µf 660 v ac 6%	General Electric	49F2322
C301	117-0087	Ceramic	0.1 µf 500 v + 80, -20%	Sprague	41C92
C302	117-0291	Mylar	0.03 µf 200 v 10%	Hopkins Eng.	P032M
C303	117-0125	Electrolytic, Pigtail Type	100 µf 25 v +100, -10%	Industrial Cond.	/1B1064
C305	117-0147	Electrolytic, Pigtail Type	10 µf 150 v + 50, -10%	Industrial Cond.	10B912RM
C401	117-0114	Electrolytic, Pigtail Type	350 µf 50 v +100, -10%	Industrial Cond.	1B844
C402	117-0222	Electrolytic, Pigtail Type	100 µf 200 v + 50, -10%	Industrial Cond.	20B317RM
C403, 404	117-0221	Electrolytic, Pigtail Type	500 µf 50 v +100, -10%	Industrial Cond.	1B1163RM
C405, 406	117-0163	Ceramic	0.05 µf 500 v 20%	Sprague	36C142A1
		Rectifiers:			
CR301, 302, 403, 404	124-0028	Silicon, Pigtail Type		Automatic Mfg.	PT-5
CR401, 402, 405, 408	124-0084	Silicon, Pigtail Type		Transitron	SL. 91
F101	141-0003	Fuse, Instantaneous	4 a 250 v	Bussmann	MTH-4
F102	141-0041	Fuse, Slow Blow	10 a 32 v	Bussmann	MDL-10

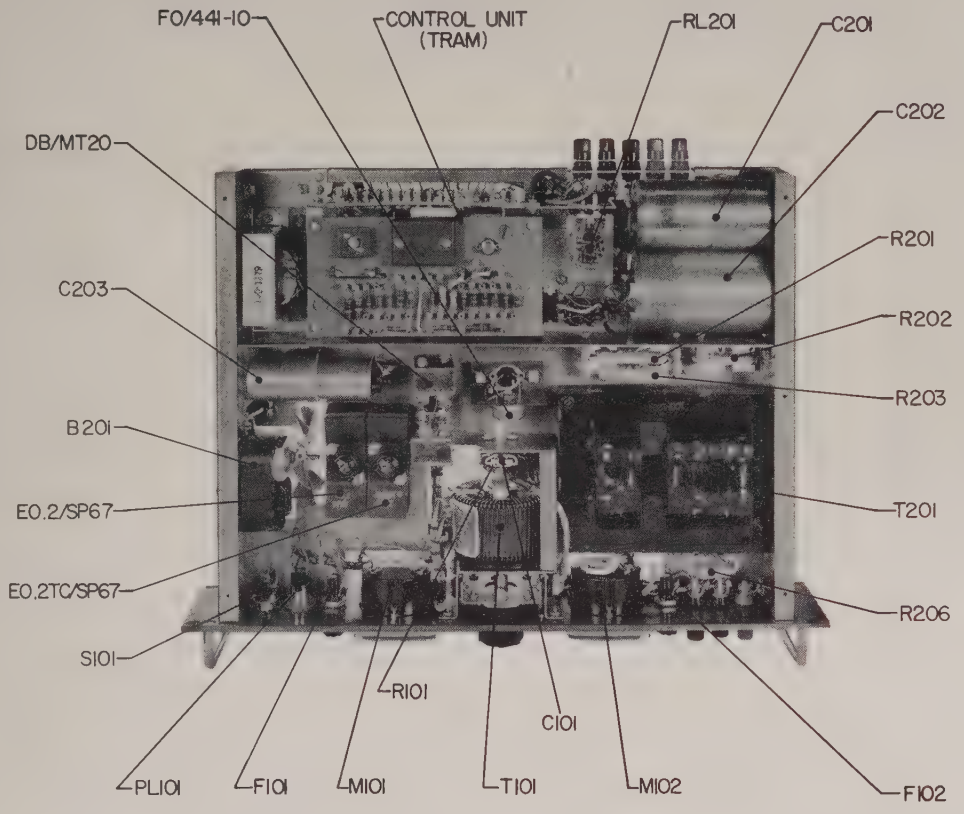
Schematic Part No.	Kepco Part No.	Description	Specifications	Mfr.	Mfr's. No.
F401	141-0012	Fuse, Instantaneous	2 a 250 v	Bussmann	AGC-2
M101	135-0195	Meter*	8 a dc 2-1/2"	General Elec.	8DW91A321BV2
M102	135-0139	Meter*	15 v dc 2-1/2"	General Elec.	8DW91V207AK2
		*(appl. only to Models SM 14-7M and SM 14-7MX)			
PL101	153-0024	Pilot Light, Neon		General Elec.	NE-51
Q301	119-0022	Transistor, PNP		Tung-Sol	2N382
Q302	119-0034	Transistor, PNP		Delco	2N1172
		Resistors:			
R101	115-0269	Variable, Wire Wound	2 K ohm 1.6 w 5%	General Radio	971-L
R201, 203	115-1018	Fixed, Power, Strip	0.3 ohm 40 w 5%	Ward Leonard	2" Stripohm-0.3 ohm 5%
R202	115-0981	Fixed, Power, Strip	1.5 K ohm 30 w 5%	Ward Leonard	30S1500
R204, 206	115-0392	Fixed, Power, Axial	150 ohm 5 w 5%	Ward Leonard	5X150
R205	115-0964	Fixed, Power, Strip	15 ohm 20 w 5%	Ward Leonard	30S15
R207	115-0718	Fixed, Molded	47 ohm 1/2 w 10%	Allen-Bradley	EB4701
R301	115-0559	Fixed, Molded	5.6 K ohm 1/2 w 5%	Allen-Bradley	EB5625
R302	115-0960	Fixed, Molded	1 K ohm 1 w 5%	Allen-Bradley	GB1025
R303	115-0564	Fixed, Power, Axial	400 ohm 3 w 5%	Ward Leonard	3X400
R304	115-0341	Fixed, Molded	100 ohm 1/2 w 5%	Allen-Bradley	EB1015
R305, 310	115-0718	Fixed, Molded	47 ohm 1/2 w 10%	Allen-Bradley	EB4701

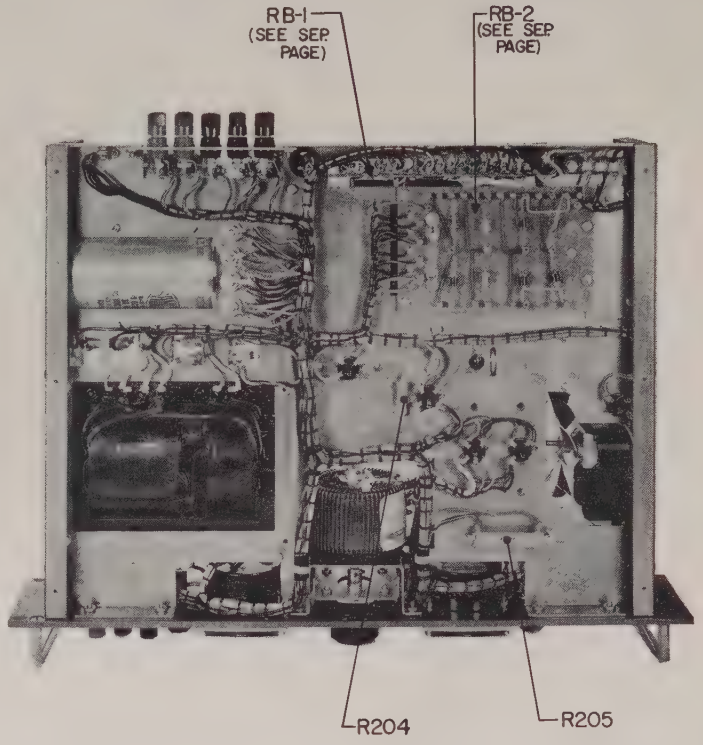
Schematic Part No.	Kepco Part No.	Description	Specifications	Mfr.	Mfr's. No.
		Resistors:			
R306	115-0809	Fixed, Molded	100 K ohm 1/2 w 10%	Allen-Bradley	EB1041
R307	115-0883	Fixed, Molded	39 0 K ohm 1/2 w 5%	Allen-Bradley	EB3915
R308	115-0516	Fixed, Power, Axial	5 ohm 5 w 5%	Ward Leonard	5X5
R309	115-0902	Fixed, Molded	100 ohm 1 w 5%	Allen-Bradley	GB1015
R311	115-0250	Fixed, Molded	330 K ohm 1/2 w 5%	Allen-Bradley	EB3345
R312	115-0512	Fixed, Power, Axial	1 K ohm 5 w 5%	Ward Leonard	5X1000
R313	115-0502	Fixed, Molded	10 ohm 1/2 w 10%	Allen-Bradley	EB1001
RL201	140-0040	Relay	3 PDT	Kurman	Q1015
S101	127-0107	Switch, Toggle	SPST	Carling	AA252-71-2
T101	175-0404	Transformer, Variable		Ohmite	SPEC47259
T201	100-1204	Transformer, Flux-O-Tran		Kepco Magnetics	100-1204
T401	100-1179	Transformer		Kepco Magnetics	100-1179
DB/MT20	109-0025	RECTIFIER ASSEMBLY (STAT)			
		Includes the following:			
4 ea.	124-0105	Rectifier, Silicon, Stud Type		Trans-Sil Corp.	MT-20
E0.2/SP67	110-0127	PASS ASSEMBLY (STAT)			
		Includes the following:			
1 ea.	115-0450	Resistor, Fixed, Power, Axial	0.2 ohm 3 w 5%	Ward Leonard	7/17"-Q-0.2 ohm Axiohm-5%
1 ea.	119-0035	Transistor, PNP		Motorola	SP67*

*Field Replacement: 2N1163

Schematic Part No.	Kepco Part No.	Description	Specifications	Mfr.	Mfr's. No.
E0.2TC/SP67	110-0126	PASS ASSEMBLY (STAT)			
		Includes the following:			
1 ea.	115-0450	Resistor, Fixed, Power, Axial	0.2 ohm 3 w 5%	Ward Leonard	7/16"-Q-0.2 ohm Axiohm-5%
1 ea.	127-0093	Switch, Thermostat	N. C.	Chatham Cont.	DRSCORP73C
1 ea.	119-0035	Transistor, PNP		Motorola	SP67*
F0/441-10	110-0128	DRIVER ASSEMBLY (STAT)			
		Includes the following:			
1 ea.	119-0016	Transistor, PNP		Delco	2N441

Schematic Part No.	Kepco Part No.	Description	Specifications	Mfr.	Mfr's. No.
		Resistors:			
R12	115-0920	Fixed, Molded	13 K Ω 1/2 w 5%	Allen-Bradley	EB1335
R13	115-0473	Fixed, Molded	1.8 K Ω 1/2 w 10%	Allen-Bradley	EB1821
R14	115-0566	Fixed, Molded	750 Ω 1/2 w 5%	Allen-Bradley	EB7515
R16	115-0466	Fixed, Molded	2.2 K Ω 1/2 w 10%	Allen-Bradley	EB2221
R17	115-0005	Fixed, Molded	47 Ω 1 w 10%	Allen-Bradley	GB4701
R18	115-0052	Fixed, Molded	10 Ω 1 w 10%	Allen-Bradley	GB1001
R19	115-0739	Variable, Multiturn	1 K Ω 1/4 w 10%	Bourns	271-1-102
R20	115-0255	Fixed, Molded	56 K Ω 1/2 w 10%	Allen-Bradley	EB5631
RD1	121-0013	Reference Diode		Hoffman	RS-6

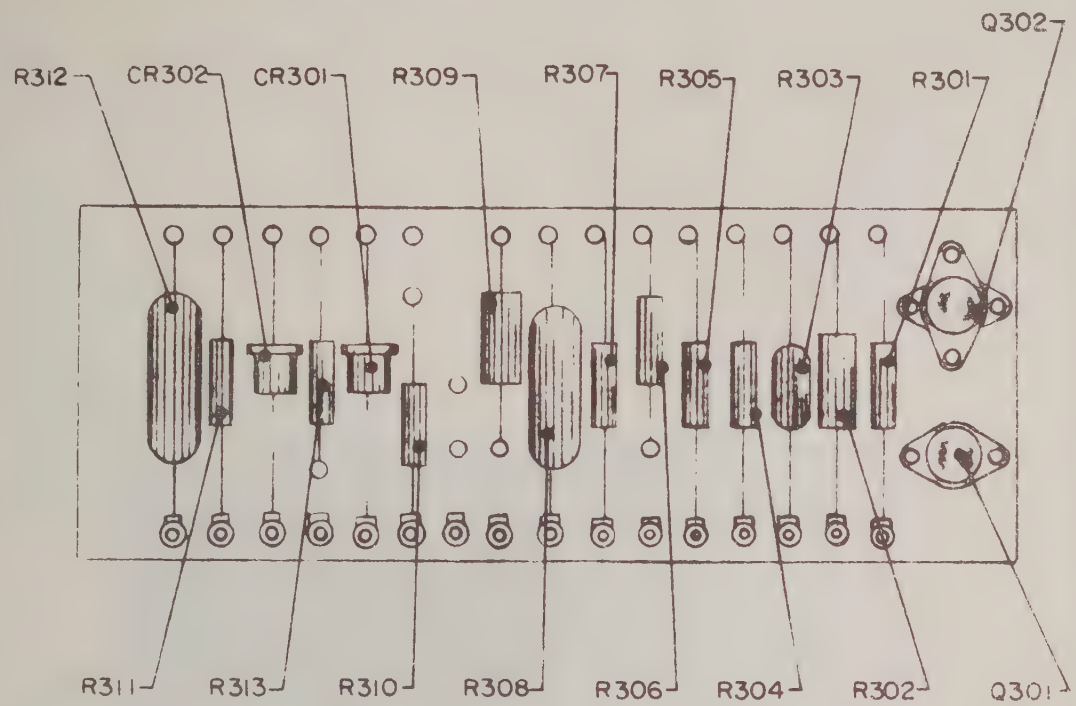


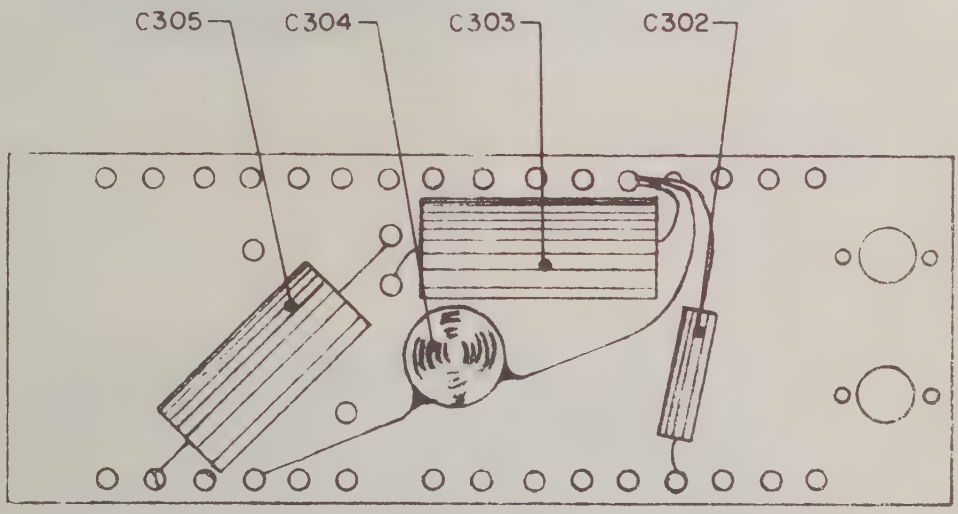


CORRECTIONS, IF ANY, APPEAR ON SHEET ATTACHED TO REAR COVER

KEPCO INC.
FLUSHING NEW YORK

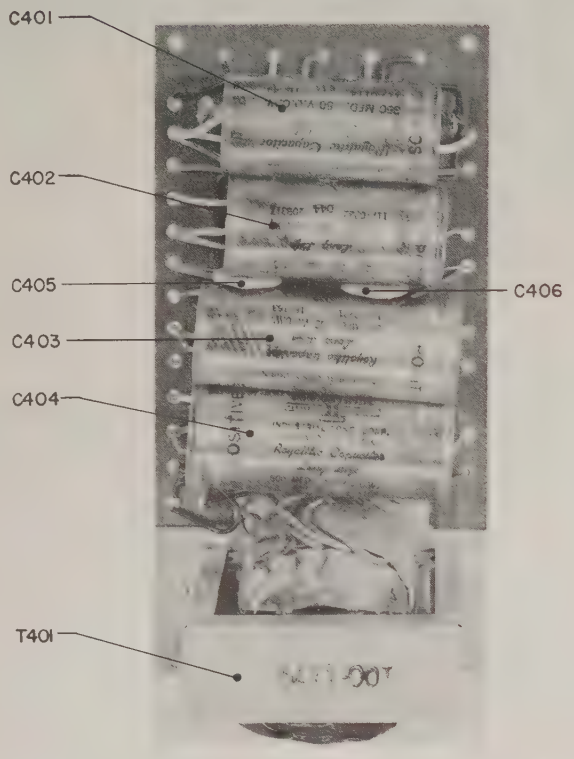
ITEM POWER UNIT	DES
	APPD JPS
MODEL SM-14-7	DFTN RC 2-28-61
DWG No CM01068	CHKD T Rd

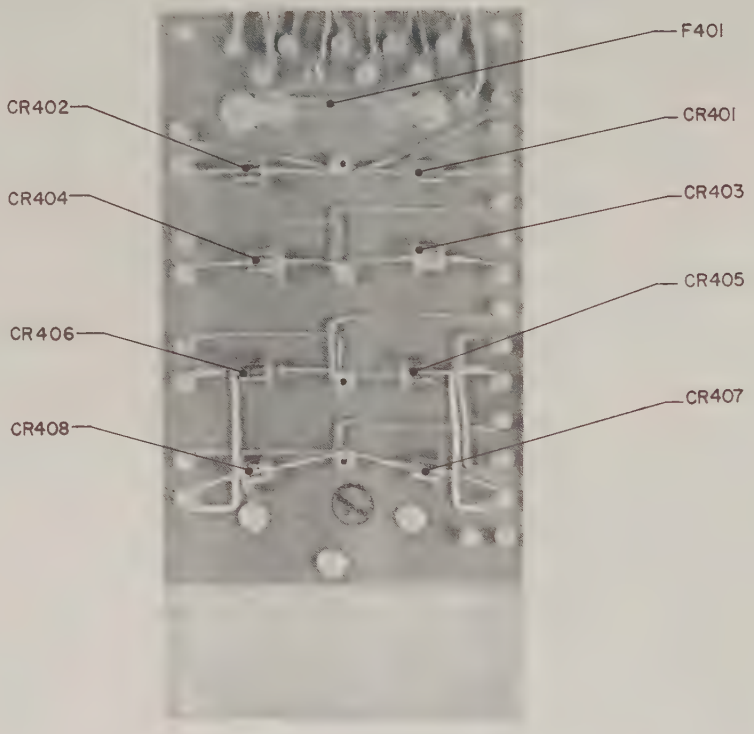




KEPCO INC.
FLUSHING NEW YORK

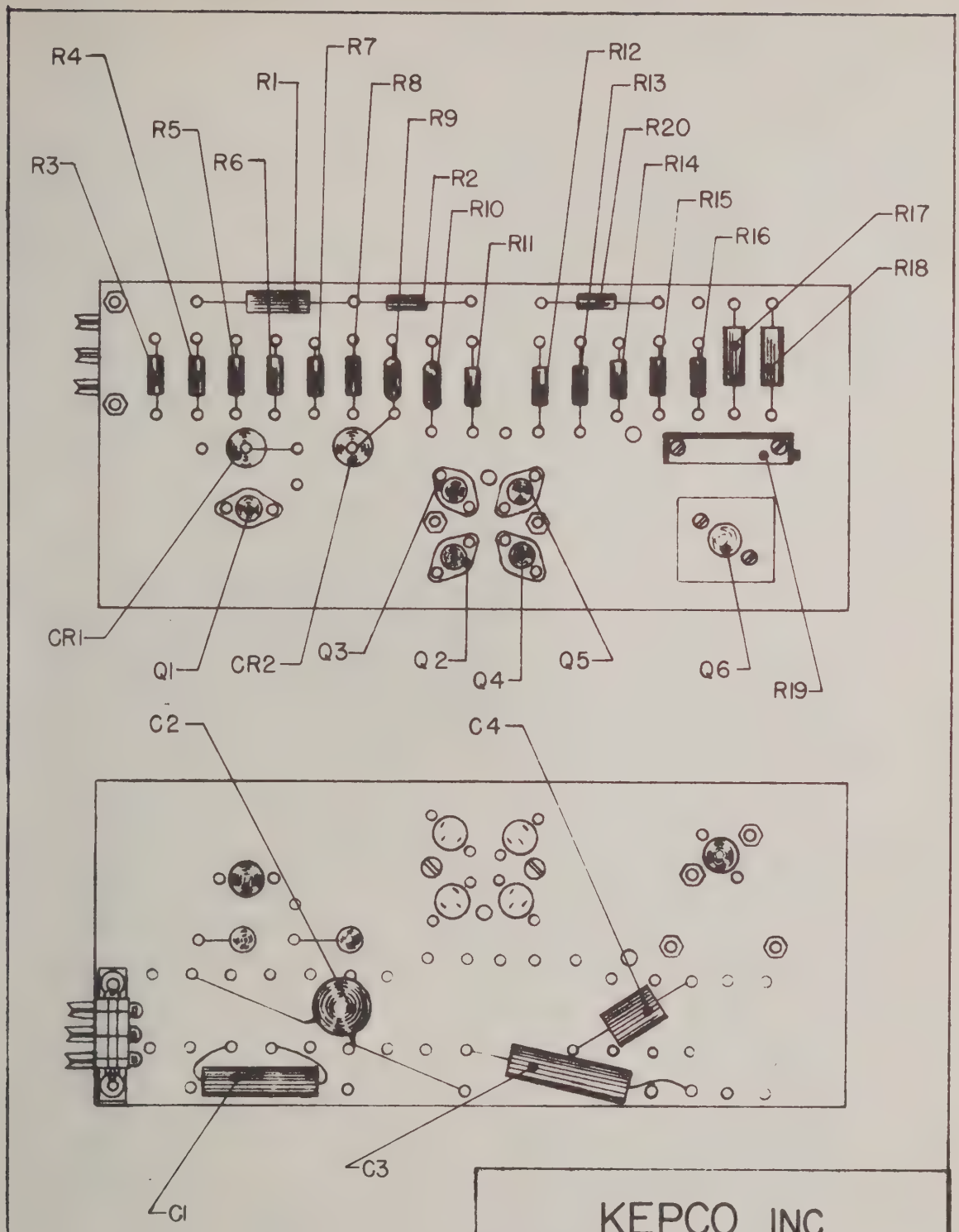
ITEM RB-1	DES 4-13-61
	APPD JPK
MODEL SM-14-7	DFTM RC
DWG No AM01067	CHKD T.D.





CORRECTIONS, IF ANY, APPEAR ON SHEET ATTACHED TO REAR COVER

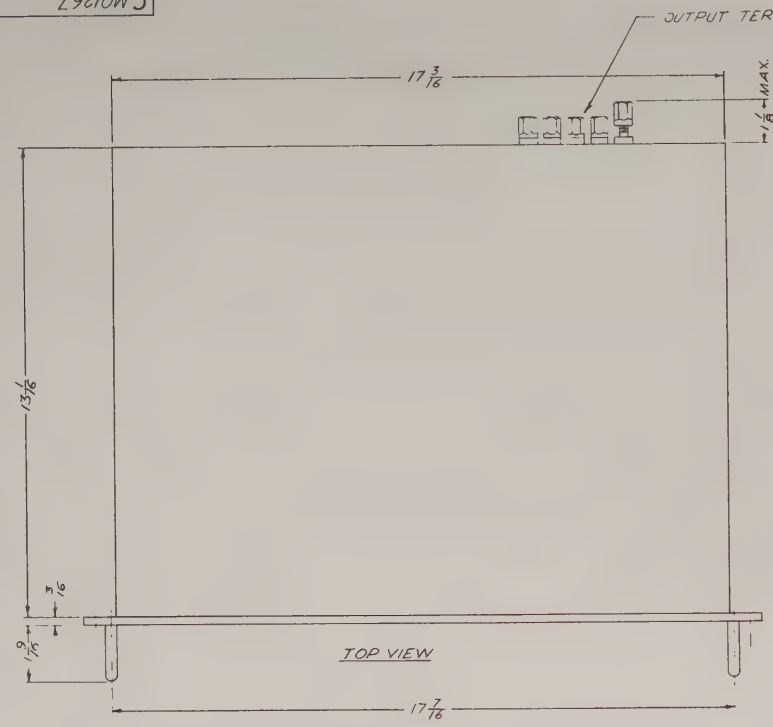
KEPCO INC.	
FLUSHING NEW YORK	
ITEM RB-2	DES. 1-3-61
	APPD
MODEL SM—— SERIES	DFTM M.CEA
DWG. No BM00923	CHKD



KEPCO INC.	
FLUSHING NEW YORK	
ITEM: CONTROL UNIT	DES 3-1-61
	APPD J.P.K.
MODEL TRAM-32	DFTM R.C.
DWG. No. AM01073	CHKD T. Bel

CM01267

REVISIONS	DRAWN	CHKD	APPD.	DATE



NOTES:
USED ON MODELS
SM-14-7
SM-36-5
SM-75-2
SM-160-1
SM-325-0.5

KEPCO INC.
FLUSHING, N.Y.

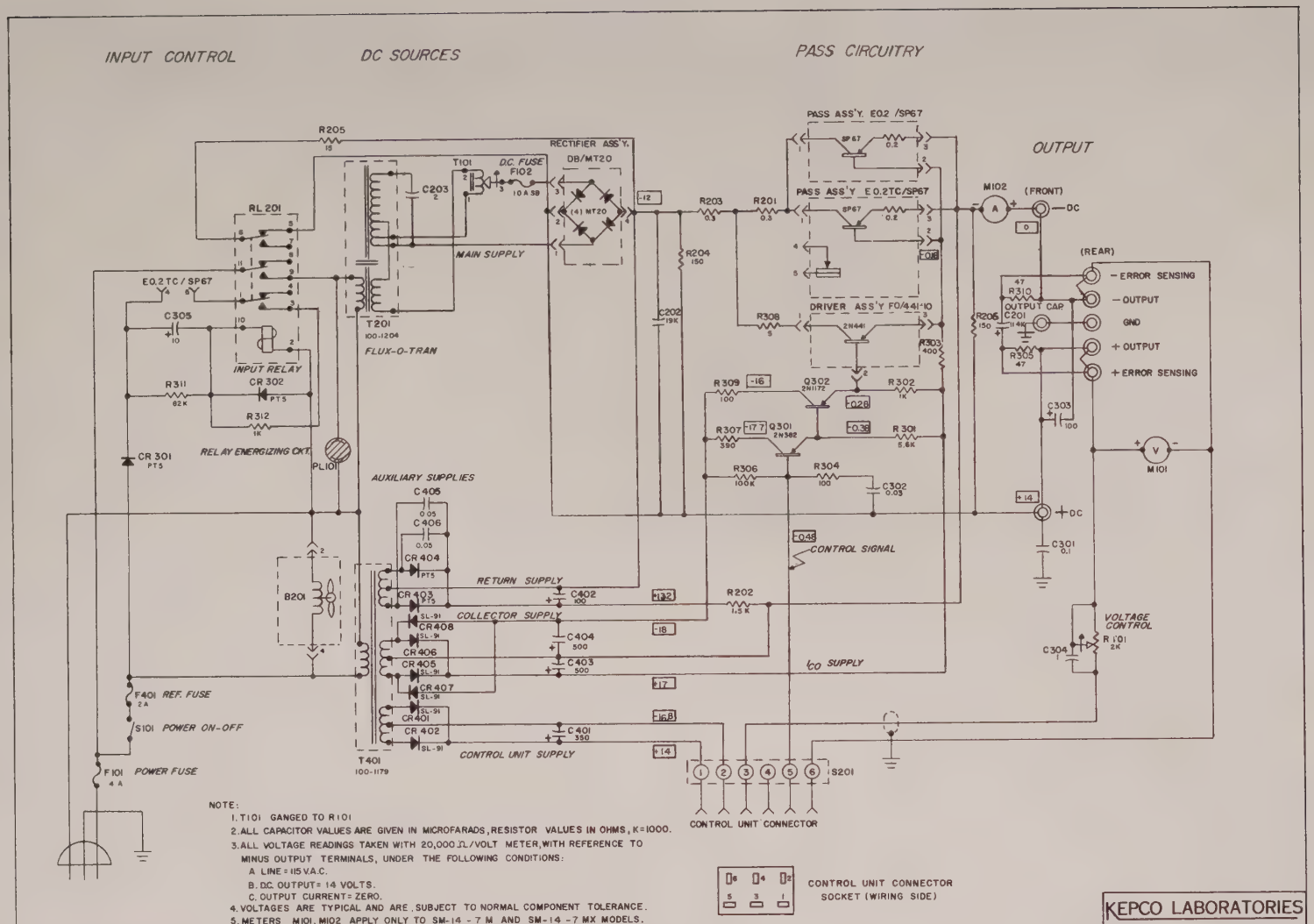
TITLE: OUTLINE DRAWING

DRAWN	CHECKED	APPROVED	DATE
R A	TRd	G Bykirk	4-19-61

MODEL NO. 3½ SM SERIES | PART NO. | SCALE: HALF

DWG. NO. CM01267

TOLERANCE UNLESS OTHERWISE SPECIFIED FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1/2°



NOTE:

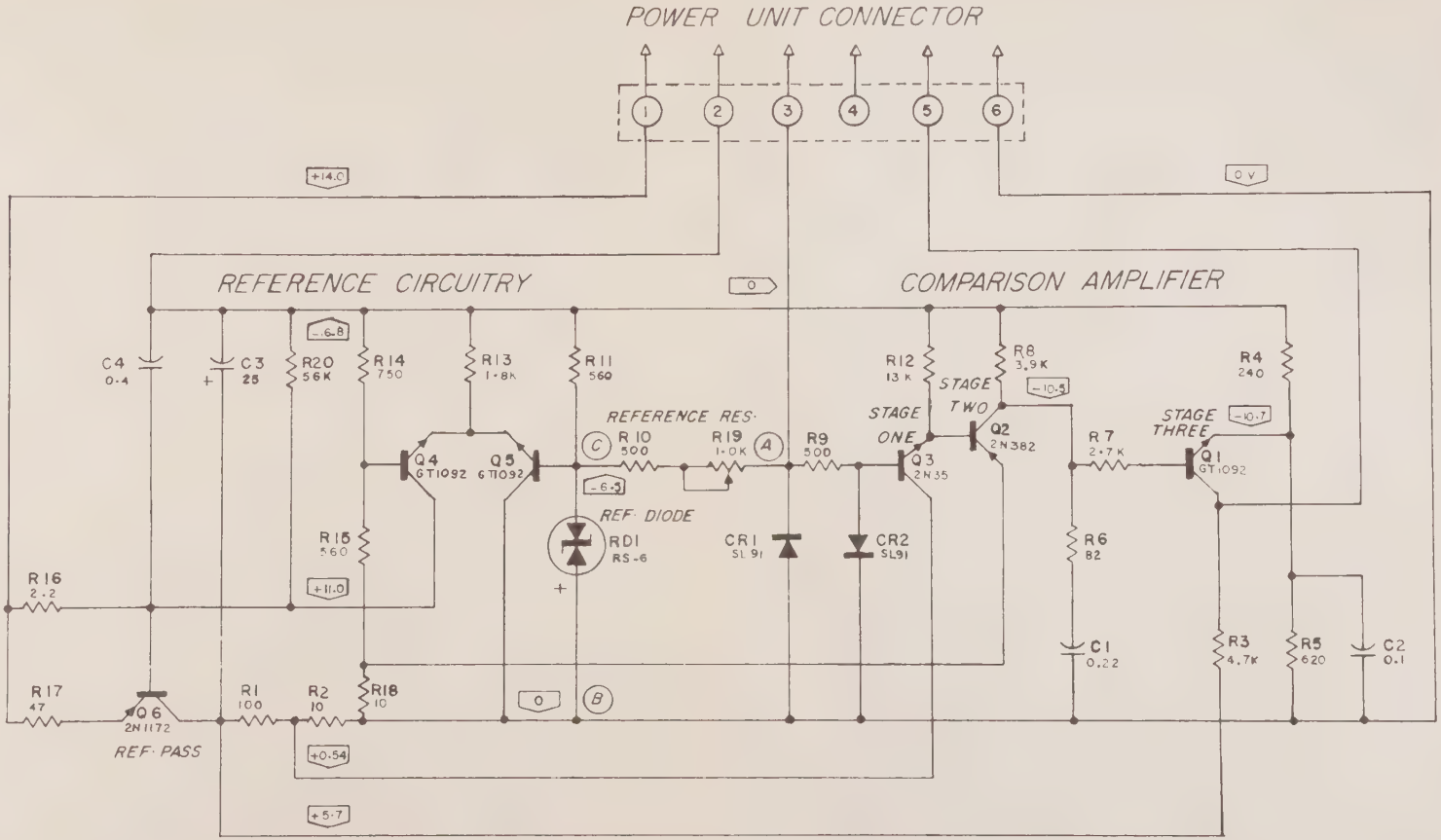
1. T101 GANGED TO R101
2. ALL CAPACITOR VALUES ARE GIVEN IN MICROFARADS, RESISTOR VALUES IN OHMS, K=1000.
3. ALL VOLTAGE READINGS TAKEN WITH 20,000 Ω/VOLT METER, WITH REFERENCE TO MINUS OUTPUT TERMINALS, UNDER THE FOLLOWING CONDITIONS:
   - A. LINE = 115 V.A.C.
   - B. D.C. OUTPUT = 14 VOLTS.
   - C. OUTPUT CURRENT = ZERO.
4. VOLTAGES ARE TYPICAL AND ARE SUBJECT TO NORMAL COMPONENT TOLERANCE.
5. METERS M101, M102 APPLY ONLY TO SM-14-7 M AND SM-14-7 MX MODELS.

CONTROL UNIT CONNECTOR SOCKET (WIRING SIDE)

See Correction Sheet On Inside Back Cover.

KEPCO LABORATORIES
FLUSHING NEW YORK

ITEM: POWER UNIT	DES. J.R.G.
MODEL SM-14-7	APPD. A. Rosenblatt
DWG. No. C-M00787	DFTR M.C.E.A. 1-23-61
	CHKD J.P.K.



NOTES.

1- ALL VOLTAGES TAKEN UNDER CONDITIONS SPECIFIED ON MAIN SCHEMATIC

2- ALL CAPACITOR VALUES ARE GIVEN IN MICROFARADS, RESISTOR VALUES IN OHMS, UNLESS OTHERWISE NOTED (K= 1,000 OHMS)

3- ORDER REPLACEMENT PARTS BY KEPCO PART NUMBER PROVIDED IN PARTS LIST SECTION.

KEPCO INC.
FLUSHING, N Y

TITLE
CONTROL UNIT

DRAWN	CHECKED	APPROVED	DATE
C A	JPK	[illegible]	12-2-60
MODEL NO. TRAM 32		PART NO.	SCALE

DWG NO. BM00790

INSTRUCTION MANUAL CORRECTION

Please note the following changes to the Manual materials as indicated:

Power Unit Schematic:

1. Add: Resistor R313, 10 Ω; in series with, and between C301 and ground.

2. Change: Schematic designation of C304 to C101.

3. Add: Resistor R207, 47 Ω; between the common connection joining pins #2 (base) and the common connection joining pins #3 (emitter output) of the Pass assembly.

4. Change: Resistor R311 from 82 K Ω to 33 K Ω.

Physical location: soldered to lugs #2 and #3 on Pass assembly socket.

Kepco inc.

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